**Question 1**

Run the model forward in time to determine when the estimated CO2 reaches 600 ppm. (You will need to change the Run Specs to do this.) Give a brief qualitative explanation of how you think this increased CO2 concentration will affect global climate.

Be sure to cite relevant scientific information to support your answer and include the date determined above.

Include your STELLA graph of Atmospheric CO2 (ppm) and note the value you used for fossil fuel combustion. (Lock the lock icon on the graph and be sure to label the graph so it’s easy to see which graph shows future scenarios).

Atmospheric CO2 reaches 600 ppm at the year 2050. Scientists know that with increasing CO2 concentrations global warming occurs, therefore the Earth’s average temperature increases. This increase in temperature is global, and as the Earth grows warmer the glaciers and ice at the poles, which contain a massive amount of water, begin to melt and as a result the sea level rises. The rise in sea level affects everyone. Coastlines become more inland, altering the environment in the area, organisms in the ocean must adjust to warmer water and new depths, thus they may travel to different areas, creating new relationships in the ecosystem in that area, that did not exist previously. The increase in temperature also increase precipitation, and the possibility for hurricanes, since hurricane form over warm water, the ocean’s surface temperature is increasing with the increased global temperature. This also alters the environment for many species. Besides these factors global warming affects almost everything. See: <http://www.americanprogress.org/issues/2007/09/climate_100.html> for 100 effects you may not think of.

References:

<http://en.wikipedia.org/wiki/Effects_of_global_warming>

<http://www.americanprogress.org/issues/2007/09/climate_100.html>

**Question 2**

Explain the annual seasonal variation that you built into your model and that you see in the Mauna Loa graph. What is the biological mechanism for this cyclical fluctuation?

As the seasons change so does the amount of photosynthesis that is occurring among plant life. During the summer photosynthesis takes in CO2, therefore, the CO2 levels in the atmosphere decrease. However, plant life is less abundant in the winter, therefore the photosynthetic rate decreases, causing a decrease in the amount of CO2 being taken in. This creates the individual increases and decreases in the Mauna Loa graph.

**Question 3**

Look at the processes in the global carbon cycle, and identify the anthropogenic (human-made) factors. By altering one or more of these, develop a possible future scenario of the carbon cycle and model it in STELLA.

Post your new (relabeled) graph of Atmospheric CO2 (ppm) and label clearly. Describe the factors you changed and how these changes affected global climate.

The anthropogenic factors of the carbon cycle would be fossil fuel consumption and deforestation. Both of these contribute to the amount of carbon in the atmosphere.

By keeping the value for fossil fuel combustion the same from year 2008 to year 2058, at a value of 0.00 for all years, the graphs shows that the increasing fossil fuel combustion is what causes the exponential trend in atmospheric carbon. (Once fossil fuel remained the same the graph became linear). Now (take note of the scale) the value does not reach 600 ppm until sometime after 2058.

Fossil Fuel Combustion:

Once deforestation was changed from a value of 1.8 to a value of 0.8 the graph retained its exponential shape but increased at a slower rate. Now the atmospheric carbon ppm does not reach 600 ppm until 2055.

Deforestation:



**Question 4**

Given the mass balance calculations that have been done with known concentrations of atmospheric carbon, we need a "sink" to balance the global C budget. In other words, we are "missing" over 2 billion tons of C each year; this shows how incomplete our understanding of the global carbon cycle is at present. What are some of the scientific speculations about where this missing sink could be located? Name at least two.

One hypothesis about the missing sink is that with an increase in CO2 level, the plants are photosynthesizing more, since CO2 is a main component in photosynthesis the plants are able to synthesize and take in the CO2. With areas with abundant plant population like the rainforests this sink is quiet affective in taking out some of the atmospheric CO2.

<http://www.nature.com/climate/2007/0708/full/climate.2007.35.html>

Another hypothesis is that peatbogs in the boreal forests can account for the “missing carbon.” Because many of the peatbogs are in the Northern half of the world and scientists have now made studies and got conclusions that the missing sink is in the northern part of the Earth it is quiet possible that they are the missing sink we have been looking for. Scientist say that the reason it would make sense to be such a carbon sink is that, “ when the Sphagnum moss, which grows on the surface of the bog, or the leaves of plants or trees die in this wet environment, the detritus eventually sinks the 50 cm to two metres below the water level to the dense peat where it decomposes in the absence of oxygen. Because anaerobic (without oxygen) decomposition is far slower than aerobic, the loss of carbon dioxide to the atmosphere, a usual result of decomposition, is greatly slowed.”

<http://www.mcgill.ca/reporter/32/15/roulet/>